

R: Integration of prognostic phosphorus cycle dynamics into ACME

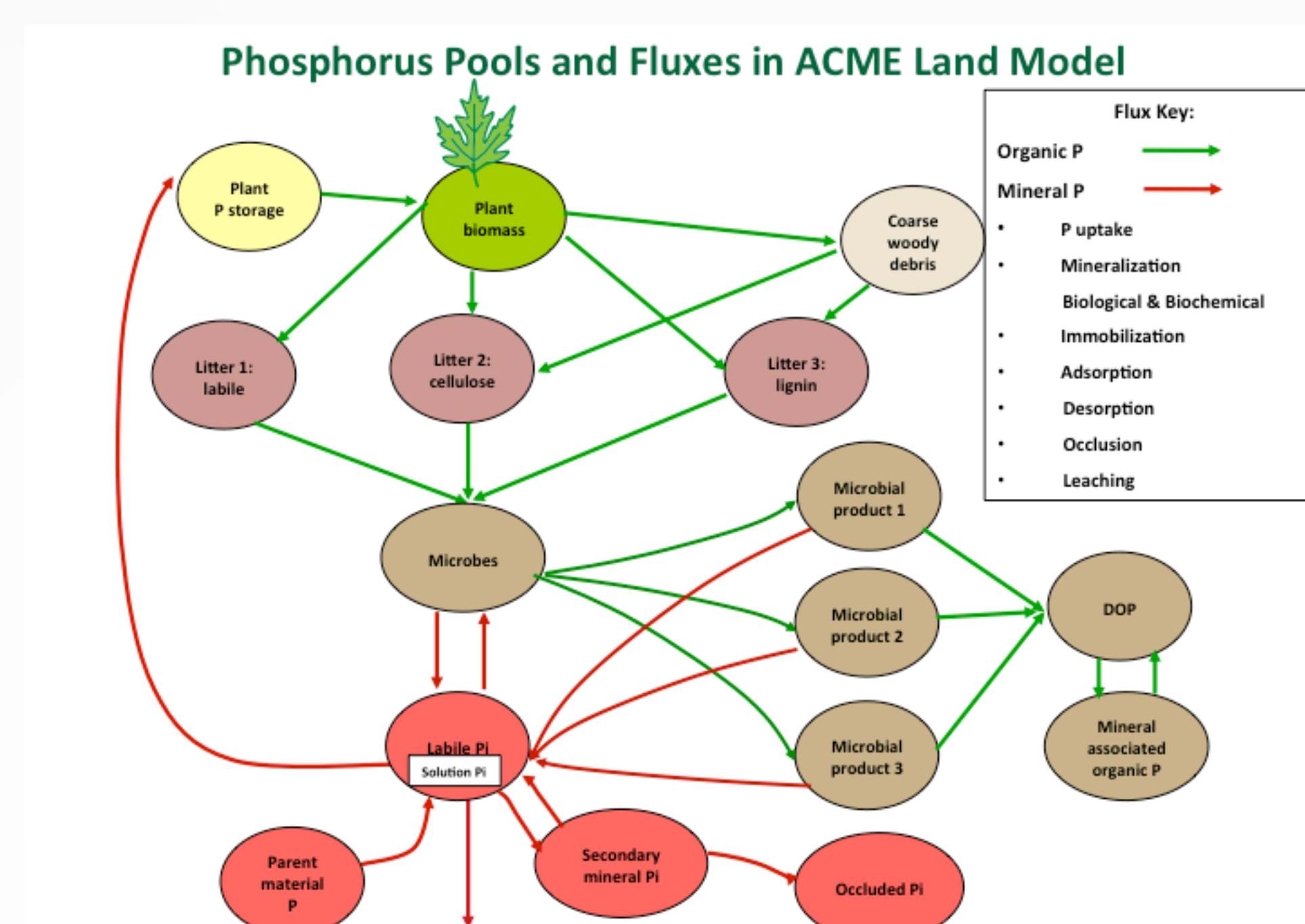
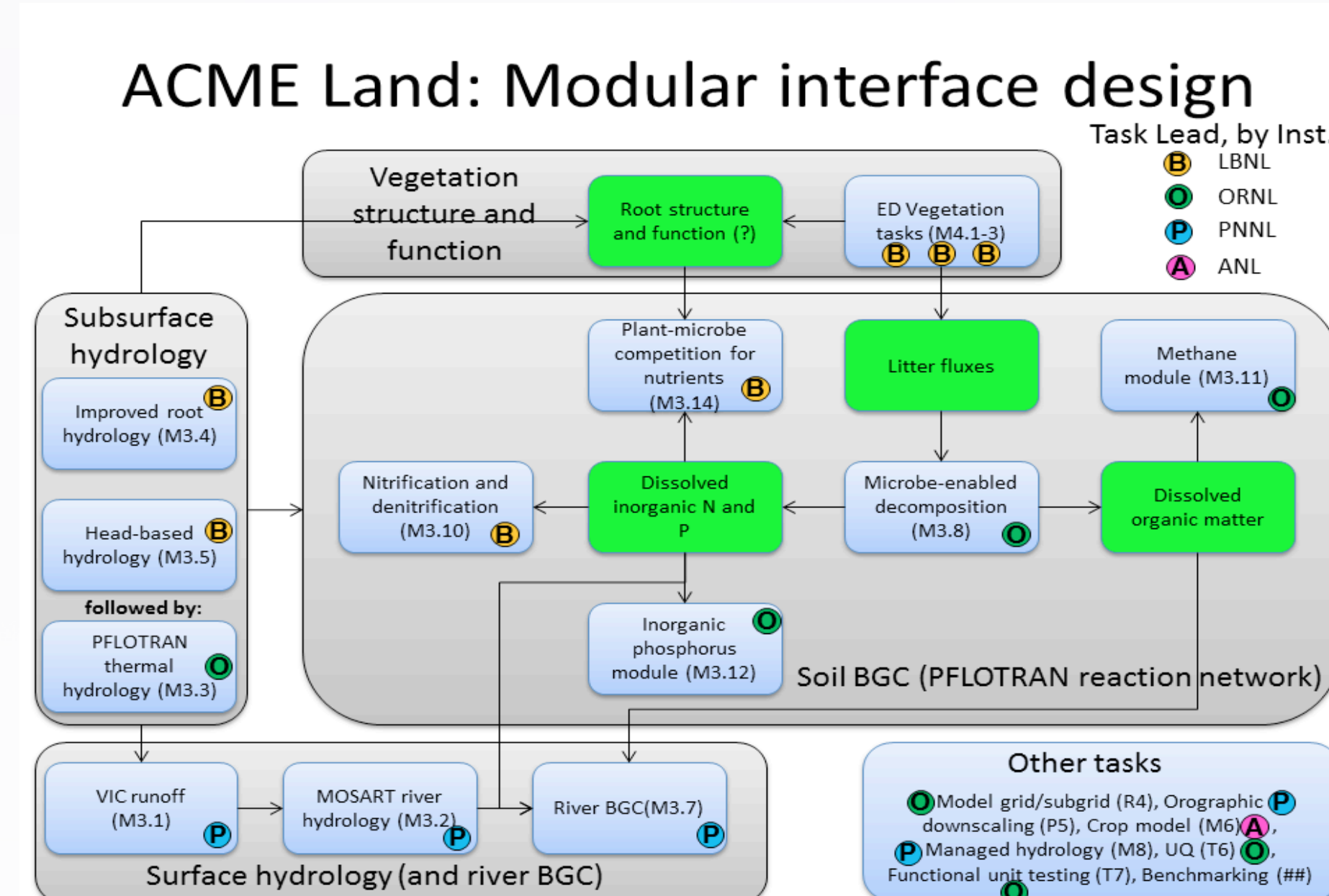
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Objective

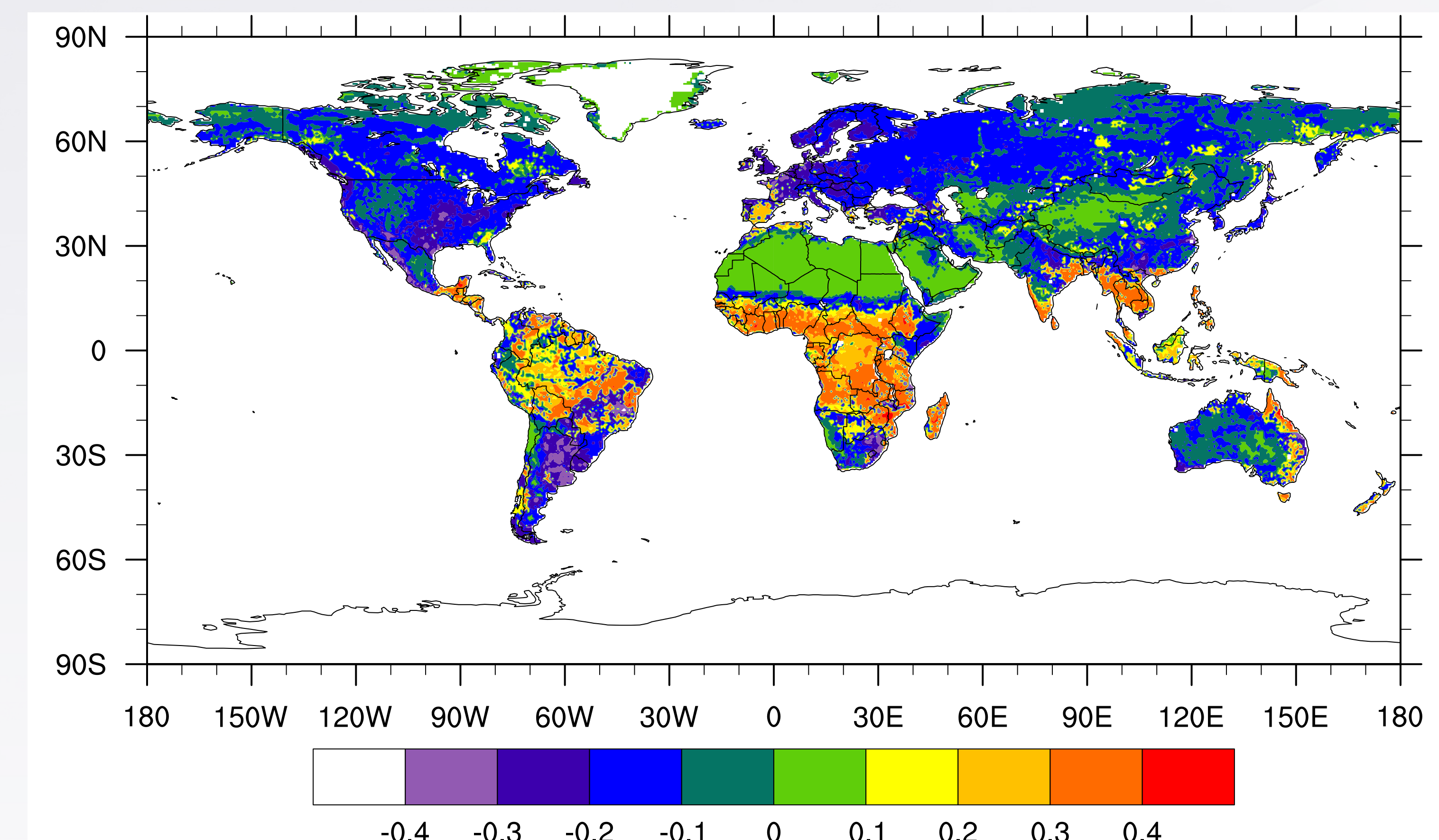
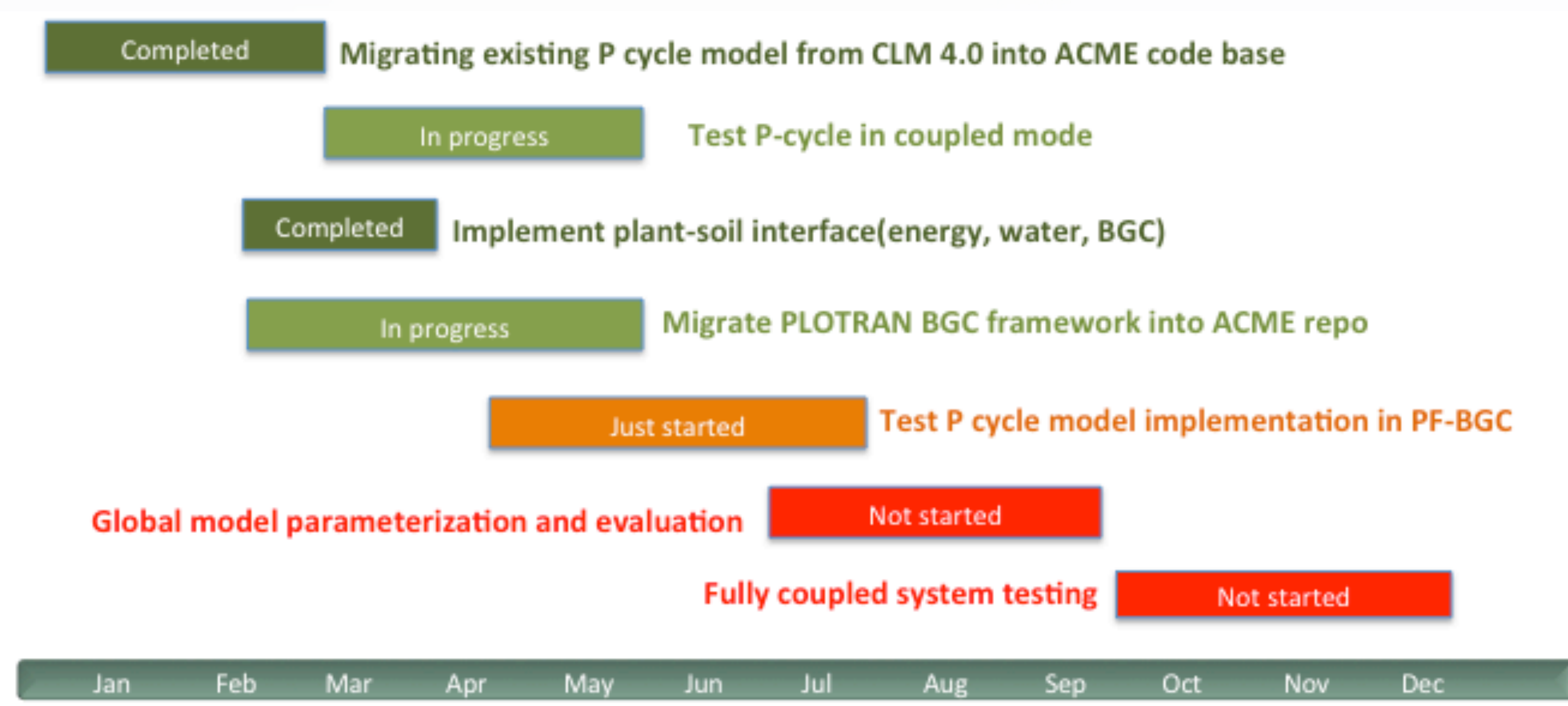
The objective of this task (land task M3.12) is to examine how the inclusion of prognostic phosphorus (P) cycle affects carbon-climate feedbacks using fully coupled simulations.

Very few Earth System Models (ESMs) has considered P as a limiting nutrient, although P limitation is widespread and is most pronounced in highly productive lowland tropical forests. In this task, we will further develop and improve exiting CLM-CNP model and integrate the improved prognostic P cycle model into the ACME land model. We will perform a series of uncoupled and coupled global simulations with different land configurations to explore the role of phosphorus dynamics in regulating climate system feedbacks.

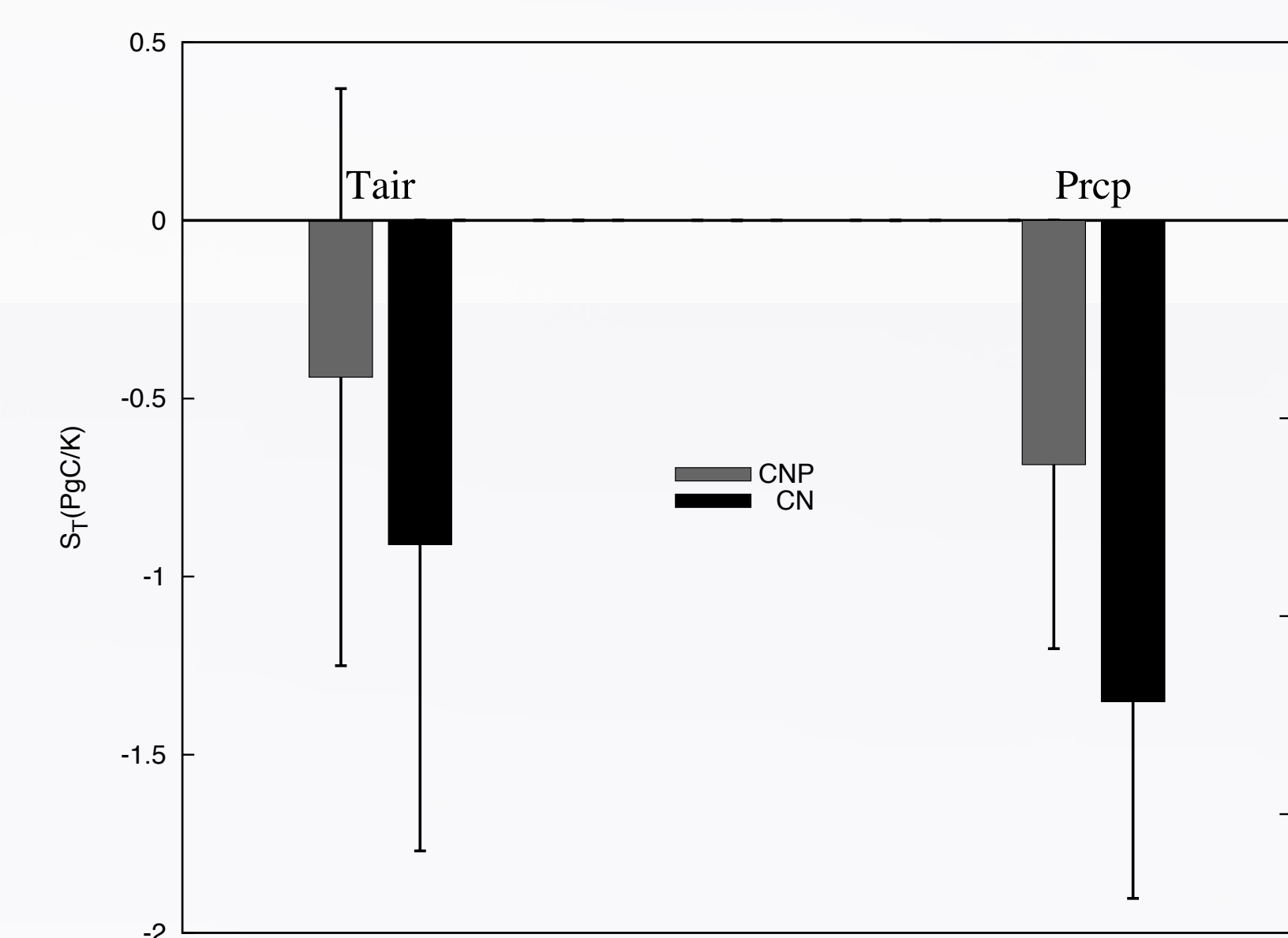
Approach



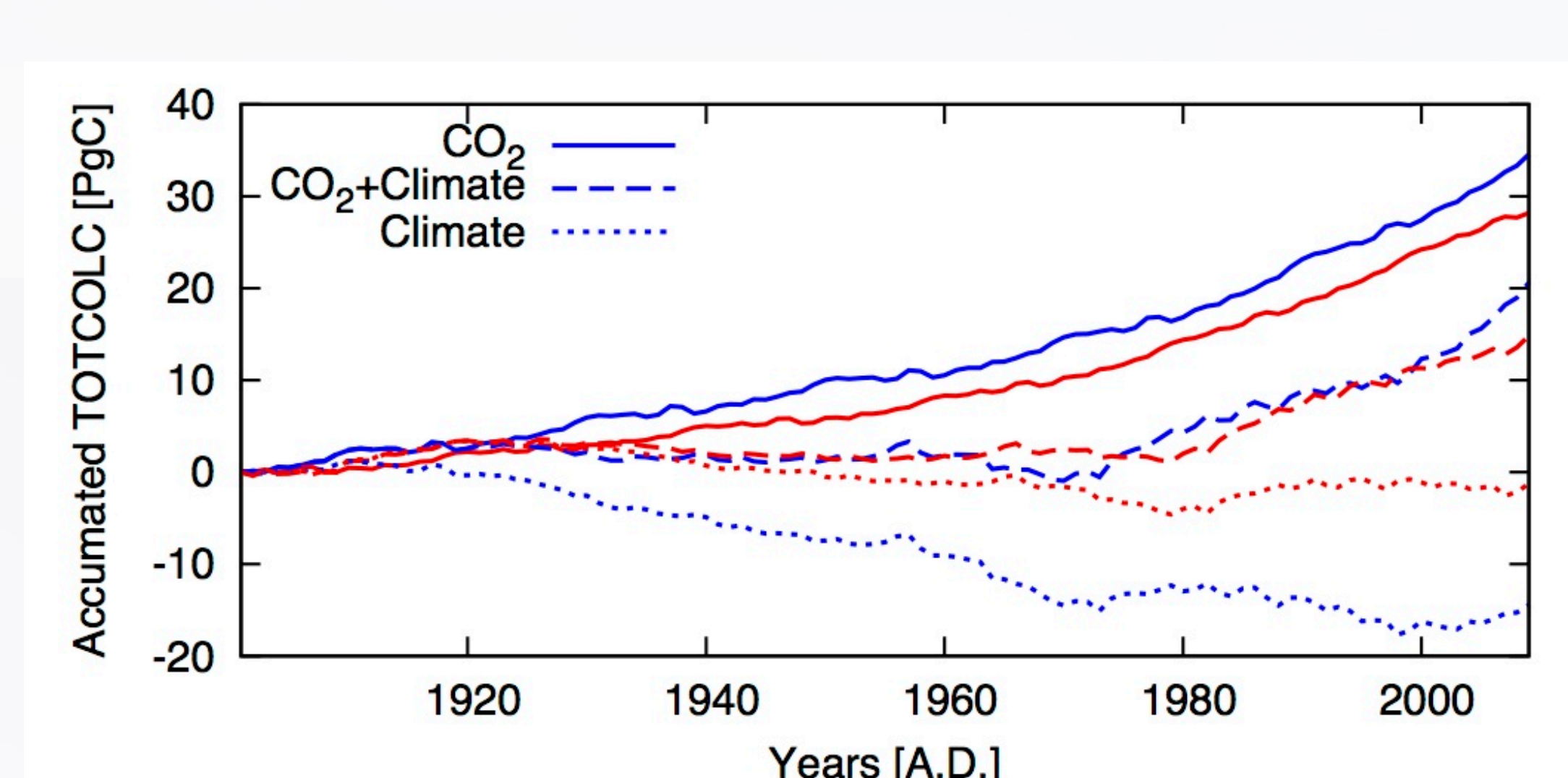
Timeline in 2015



Estimated spatial variation of nutrient limitation factor (N and P) on the global scale, based on the global application of CLM-CNP (Yang et al., 2014). Regions with a negative value are considered more limited by N, while regions with a positive value are more limited by P. The bigger the absolute value is, the stronger the limiting effect is.



Global-scale assessment of sensitivity of NEE to temperature and precipitation. Based on multiple regression estimates of slopes.



Changes in tropical land carbon storage in response to historical changes in [CO₂] and climate with and without P dynamics. Red lines are with P dynamics while blue lines are without P.

Impact

- ✧ Help improve representation of carbon cycle constraints from nutrient limitation, especially in tropical regions with known phosphorus limitation.
- ✧ Quantify the effect of accounting for phosphorus cycle dynamics on terrestrial carbon cycle responses to change in atmospheric CO₂ and climate.
- ✧ Help reduce uncertainties in predictions of carbon cycle-climate feedbacks and improve future climate prediction